SCIENCE

VOL. LXXII FRIDAY, NOVEMBER 14, 1930 No. 1872

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

CHEMISTRY AND EDUCATION[1]

By Professor WILLIAM McPHERSON

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NEARLY a century and a half has passed since chemistry was first recognized as a subject worthy of study in our colleges. Maclean in his "History of the College of New Jersey" states that this college as early as 1795 included chemistry among the subjects for the study of which provisions were made. Other reputable universities of that day soon followed, and early in the last century chemistry was a required study in the course in liberal arts at Columbia, Harvard and Princeton. This new-born infant, however, was not received with any great cordiality into the family of studies that had long constituted the essentials for the baccalaureate degree. Its growth was impeded in many ways, and there were times when there was some fear as to whether it would survive the rigors of doubt and suspicion to which it was exposed. Years were to pass before laboratory work was offered as an essential part of the course, and even then in some of the colleges, at least, the students electing laboratory work were regarded with suspicion as to their sanity. They were thought by some of the classicists to be allied with the alchemists of old, who sought in secret places to transform the baser metals into gold, or to discover that mystic something that would bring perpetual youth to its fortunate possessor. Gradually the science won its way, even though there were few students and the library and laboratory facilities were very meager. The following quotations taken from the reports of the professor of chemistry, fifty years ago, in a university that to-day has a laboratory costing more than $1,000,000, adequately equipped, and with an enrolment of 3,000 students in the department of chemistry, will serve to give us some insight into the conditions for studying chemistry at that time:

Five students took the course in general chemistry; in analytical chemistry we have two students, one of

[1] Address of the president of the American Chemical Society, Cincinnati, September 10, 1930.

whom is ready to begin his course in quantitative analysis. . . . At present the chemical library of the University consists of Watt's Dictionary—a valuable work, but not fully supplying our needs . . . we have begun to take a chemical journal. . . . A Chemical Hall is needed with which also the mining and metallurgy could be associated. This need not be an expensive structure; for $20,000 a building could be erected that would provide ample room and the very best facilities for carrying on these important departments.

Evidently in those days as in the present not all the students were adequately trained, for we read:

I regret to add that the class is hampered by a few students who are not well prepared for the work. It is probable that some, if not all of these ill-disciplined pupils will fail to pass their first examination.

Janitorial troubles there were in those days, even as at the present time, for we read again:

Each laboratory, in addition to its hood has four flues that must remain open whatever may be the theories or the practices of the janitor. It has, also, subject to the will of the janitor, an opening extending the whole length of the ceiling and open to the sky.

But a great change has taken place. Opposition to the study of science gradually gave way, and interest grew apace, so that the present century and especially the last decade has witnessed a growth in the appreciation of chemistry and in the provisions for its study in our schools and colleges far beyond any expectations. Laboratories, a number of them costing in excess of $1,000,000, have been built and furnished with all the equipment necessary for instruction and research. The enrolment has increased correspondingly. In the twenty-nine universities belonging to the Association of American Universities, there were registered in one or more courses of chemistry during the last year more than 25,000 students. According to the statistics compiled by Mr. C. J. West, of the National Research Council, the number of graduate students engaged in research in the various fields of chemistry increased from 1,700 in 1924 to 2,498 in 1929. Of this latter number, 1,200 were candidates for the master's degree and 1,298 for the doctor's degree. A recent bulletin published by the Federal Office of Education lists statistics of more than 1,000 colleges and professional schools. Counting but an average of 50 students in chemistry in each of these (a very conservative estimate) the number of students of chemistry in these institutions exceeds 50,000, to say nothing of the large number of such students in our secondary schools.

Many causes have operated to bring about this growth in the appreciation of our science. The great industrial development of recent years has created an unprecedented demand for trained chemists, a demand reflected in the number of students electing chemistry as their major course. The war made vivid the possibilities of our science and led to an increased willingness to provide adequate facilities for its study.

But along with these factors is another, which, I fear, teachers of chemistry absorbed in their work have been slow to recognize. I refer to the new views regarding education and the educative process. We are living in a rapidly changing world. Those of us at all mature in years have witnessed the unearthing of fundamental knowledge such as no other generation has ever witnessed and, some would say, more than have all other generations together. It was only about thirty-five years ago that Thomson first found conclusive evidence of the existence of the electron; indeed, most of us recall the time when the atom was regarded as a single indivisible particle, true to its name. Following closely on the discovery of the electron came the X-rays. The invention of the radio and of wireless communication is well within the memory of the youngest of us. The Wright brothers flew their first airplane on the sand hills near Kitty Hawk, North Carolina, in 1903. Automobile statistics list in 1896 only four gasoline auto cars in this country; one of these was in a museum, and another wouldn't run. To-day there are 25,000,000, and in place of going miles to see one, as I recall doing, we must watch our step to avoid one.

Along with this rapid growth in knowledge of our science and in its application to useful ends has come also a growth in appreciation of the value of education and a desire to share in its advantages. The number of students in our high schools increased from 500,000 in 1900 to 4,500,000 in 1930. In the same period the registration in our higher institutions of learning (colleges, universities and professional schools) has increased from 250,000 to 1,000,000, while more than 50,000 students are registered in our graduate schools alone. We have often heard the statement that the great teacher is born, and not made, yet to-day we find colleges of education on every hand, and we hear much of "teacher training." Adult education is coming to the fore, and even the air is filled with college courses. One has only to press the right button to bring to one, offhand, a course in almost any desired subject. Our whole nation is, indeed, going to school.

This increasing appreciation of the value of education has been accompanied, and naturally so, with much discussion as to the aims of education and the most efficient methods for obtaining the desired ends. Educational organizations of all kinds have been formed, new journals dealing with educational prob-

lems have sprung into existence, new ideas are being tested and the curricula of our schools and colleges are being modified to accord with our modern ideas. Bureaus devoted entirely to research in the field of education are finding a place in our universities, and to-day one hears almost as much about educational research as about chemical research.

Many of us, at least, have been suspicious of the modern emphasis upon methods of teaching as likely to overpower attention to content, fearful that popularization might stifle the spirit of mastery and investigation. Naturally, among the many presentations of ideas, some will appear beside the mark—even nonsensical. But it will not do for us to dismiss all this discussion with a mere wave of the hand as the lightly spun and passing theories of those who might well be engaged in something more worth while, something, we might say, more scientific and less philosophical. To ignore the writings in the field of education to-day of such thinkers as Dewey, Whitehead, Eddington, Bode, Barry and others is a reflection not upon these great scholars, but upon ourselves.

For we must keep in mind that the members of the instructional staff of the departments of chemistry in our colleges and universities are not only chemists, but teachers as well. The teacher of chemistry should be just as much concerned with what is new and of value in the theory and aim of education as the teacher of psychology or of English. Interest in research should not diminish interest in teaching. It sometimes seems to me that our appreciation of the teacher is declining. One of the most difficult positions to fill in our departments of chemistry to-day, and to my mind one of the most important, is that which has to do with guiding the instruction of the students in the basic introductory course. Men adequately trained in chemistry more and more seem to think it beneath their dignity to have anything to do with the beginner, apparently forgetful of the fact that the great chemists of all times regarded the introductory course as being of so much importance that they were unwilling to trust it to any one other than themselves.

As to methods of instruction, I confess that if by method one means order of presentation, proportion of lecture to quiz, etc., etc., I have never been able to become enthusiastic over their importance. But if by method is meant such an ordering of classroom and laboratory as will develop in the student alertness, mastery, self-guidance and the reseach spirit, then method is important; there must be certain fundamental principles underlying all successful methods of teaching, important and worthy of study, and teachers apparently brilliant may fail of results because of lack of them.

But whatever may be the facts concerning the value of the study of methods, there certainly can be no doubt as to the value of the study of the aims of education; for if we are to do effectively we must have a very definite and clear-cut idea as to what we are attempting to do. It is especially essential that teachers of chemistry be familiar with the best thought of the day concerning the aims of education. For, to a constantly increasing extent, chemistry is taking its place as one of the fundamental subjects included in the liberal arts curricula of our colleges. All evidence points to a constantly increasing appreciation of the value of our science as a constituent of these curricula. "More and more," says a writer, "science will find its way into our college courses, for what we need and what we must have is significant knowledge." The one thing that may interfere with this increasing appreciation will be the failure on the part of the teachers of chemistry to understand that they are not being asked to make technical chemists of the students in the basic introductory course but to provide a piece of genuine scientific training, however limited, that shall lead students to understand, to trust and to appreciate the scientific habit of mind as one of the great determining factors of our civilization, and that shall put them in possession of those fundamental principles of science, serviceable whatever be their walk in life.

There has been much discussion as to whether chemistry viewed in this way as a constituent of the course in liberal arts should not have a different treatment from the course arranged for our future chemists. We have, at least, a name for such a course; but in the main, the discussions have had little influence on the character of the course.

Two methods of procedure are open to us. (1) We may separate our students into two classes, according to whether or not they expect to make chemistry their life work, and give to each class courses differing fundamentally in character; or (2) we may so shape our introductory course that it will serve the aims of education and be of value to all students alike. The first of these methods is open to the very serious objection that the course offered to the general student is likely to resolve itself into a collection of facts pertaining to chemistry, interesting undoubtedly, but serving neither the aims of education nor those of science—enjoyable bedtime reading but out of place in serious college work. Equally true, the technical course might miss many of the suggested and cultural values. It would seem entirely possible to frame a course that would be of value to all alike, providing a foundation knowledge of the science of chemistry but stressing acquaintance with fundamental laws and principles; also habits of clear thinking and inde-

pendent judgment such as contribute to constructive ability and ultimately to good living as well. Many a liberal arts student not supposing himself interested in science through such a course has had awakened the profound intellectual passion of his life.

With the belief that the basic introductory course in chemistry should be of such a character as to make it serve all students alike, the future chemist as well as the non-chemist, I propose to select one or two of the fundamental ideas concerning education that seem to me especially applicable to such a course. In doing this I shall quote directly or indirectly from such authorities as Dewey, Whitehead and Barry, for, as expressed by a recent writer in the *Atlantic Monthly,* one can not write intelligently concerning education to-day without finding oneself sooner or later cribbing from one or another of these leaders of educational thought. Moreover, I am only too well aware how inadequate the necessary condensation will seem to scholars in this field.

In brief, we are passing from the static, receptive idea of education to the dynamic idea; from the view that education consists in the mere accumulation of knowledge as an end in itself to the view that knowledge is to be sought in order that it may be used to invent, to create, to control; from an idealization of the past to an immediate concern with the present, based upon the power of scientific control. The past is our storehouse of experience and the foundation under our feet, and is of value just in so far as it is of service in guiding us into larger knowledge and into those uses and applications that contribute to right living. "Education is the art of utilization of knowledge," says Whitehead. "The only use of knowledge of the past is to equip us for the present. . . . We must beware of inert ideas, that is to say, ideas that are received into the mind without being utilized, or tested, or thrown into fresh combination." Education, then, is intimately connected with right living, with the ability to understand and relate ourselves to the civilization in which we live.

In a process of education as so conceived, we are using, and developing by using, the scientific method or habit of thought. Indeed, it is this development of the scientific method or habit of thought which is the scientist's fundamental contribution to the educative process. "From the humanistic as well as from the purely intellectual point of view, the general acquisition of scientific knowledge is of far less consequence than the inculcation of the scientific habit of thought" (Barry).

What then should be the character of our introductory course in chemistry, to the end that it will be in harmony with these modern views concerning education, and with the function of the contribution to be made by scientific training?

(1) In the first place, the subject must be chemistry, sound chemistry, fundamental chemistry; not a mere collection of interesting facts illustrated by striking experiments in which the fireworks entirely blind the students to the principles involved. Not facts in chemistry, although these are important, but ability to think in the domain of chemistry must be the chief end. Chemistry lends itself so admirably to a display of that which partakes of the miraculous that it is difficult at times for the teacher to keep from lapsing into the rôle of the prestidigitator. There is much to be said for the insistence of the late Johannes Thiele that all apparatus used in illustrating his lectures should be of the simplest possible type, most of it home-made, so that the principle to be illustrated rather than the apparatus used should engage the attention of the student.

I may be wrong, but I can not help believing that at the present time we are overstressing the popular side of chemistry to the detraction of the science itself. Popular chemistry has its place, a very important place, and we owe a great debt of gratitude to men like Harrison Howe and to our late lamented Edwin Slosson, who wrote accurately and interestingly concerning the affairs of chemistry in a way that the average person, wayfarer though he might be, could understand. We are greatly indebted also to the Chemical Foundation, and especially to Mr. and Mrs. Francis P. Garvan, for their generous aid in arousing a wide-spread interest in chemistry. But when popular chemistry finds its way into our high schools, and it is doing so, and even I fear into some of our colleges, not as an addition to but as a substitute for the side of chemistry that must prevail if our science is to serve either the aims of education or the development of the science itself, there is cause for serious thought. There is a great demand to-day, especially in our high schools, for the so-called practical chemistry, a demand that is reflected in the advertisements of our text-books in chemistry; and some seem to forget that all so-called practical chemistry to be of any value must be based upon fundamental theoretical principles. We must remember that the mere storing of one's mind with facts, however interesting they may be, is not education; neither is it science. All modern philosophies of education cry out against it. Henry Adams says somewhere, "I have never loved or taught facts, if I could help it, having that antipathy to fact which only idiots and philosophers attain," and one of his students has stated that "mere facts bored him. Adams-like he was unhappy unless he could get at laws, principles." "A merely well-informed man,"

says Whitehead, "is the most useless bore on God's earth." I suspect that it was the same idea that led the late Samuel Crothers to write that delightful essay on the "Honorable Points of Ignorance." We may well ask ourselves whether in our introductory course we are not overstressing the merely interesting and the entertaining, giving too much time to petty details rather than to fundamental principles and laws. I sometimes fear we are, and I have often wondered whether this tendency carried on through succeeding courses may not have something to do with the fact that, notwithstanding the almost lavish expenditure of money for training in chemistry in our country—far beyond that of any other nation—only one Nobel prize in chemistry has found its way to our shore.

(2) If it be true that one of the chief aims of education is the "inculcation of the scientific habit of thought," then it goes without saying that the central aim of our course in chemistry, whether in the high school or in the college, must be the development of the scientific habit of thought in the minds of the students. We talk much about the importance of this training, but I wonder how many of us keep our teaching polarized by this idea. Bertrand Russell has said in effect that while the scientist has good ideas he is slow to practice what he preaches.

(3) The end of trained thinking is scientific control. The teacher will lose a great opportunity if he fails to lead his students to see that this method of study is applicable not alone to the solution of problems that lie within the domain of chemistry, or science in general, but also to many of those problems that affect our well-being as a nation; to the problems of Muscle Shoals and to the framing of an equitable tariff law as well as to the unraveling of the vagaries of vitamin D; to the problems connected with efficient management of our cities as well as to the determination of isotopes; to the problems confronting the agricultural interests of our country as well as to the action of chlorophyl in photosynthesis. The scientific method must be the dependence in the solution of all such problems, and when this method is cast aside, either through the urgency of immediate action or because of special interests, sooner or later the penalty will be exacted. It is a pitiable spectacle to-day that the judgment of more than 1,000 of our leading economists in regard to a subject upon which they should be preeminently qualified to speak could be disregarded by that honorable body, the Senate of the United States. It shows either a woeful ignorance on the part of our economists or an entire absence of sound judgment on the part of the Senate—you may take your choice. Our Congress would hardly pass laws affecting the well-being of the human body against the protest of 1,000 of our leading physicians; but when it comes to the consideration of ailments affecting not the human body but the body politic, even the wayfarer regards himself as capable of writing the prescription.

What we need to do is to develop in our people the *scientific mind* as opposed to the *popular mind*, and the right beginning of this must be made in all the science courses of our colleges and even in our high schools. Wolfe in his book "Conservatism, Radicalism and Scientific Method" discusses the characteristics of these two kinds of minds, and I quote briefly, although not always literally, from him:

> The scientific mind is objective, impersonal, and desire is subordinated to reason; the popular mind is subjective, personal, with reason subordinated to desire. The scientific mind is observant, significantly informed, and curiosity is impersonal and disciplined; the popular mind is unobservant, ignorant, and curiosity is personal or lacking. The scientific mind is objectively skeptical, critical, tolerant, and can suspend judgment; the popular mind is credulous, uncritical, intolerant, and jumps at conclusions. The scientific mind is constructively imaginative, fearless in facing facts and courageous in defending its scientific convictions; the popular mind is fanciful, fearful of disagreeable facts and lacking in the courage of its convictions, unless motivated by special interest or backed by authority. The scientific mind has faith in law; the popular mind has faith in whim.

This development of the scientific mind in our people is a fundamental factor in promoting the welfare of our country for, as stated by Luckiesh:

> The benefit of scientific knowledge should not and will not end with its utilization in material things. Only genius can extend the border of scientific knowledge, but the humblest man can be taught its spirit. Doubtless, human beings will always have their frailties, but as the scientific spirit infiltrates more and more throughout business and industry, and thence throughout civilization, it should develop honesty and tolerance, and make better human beings.

How else than through the discipline of some one of the sciences shall our young men and women acquire this scientific habit of mind? Is it not an obligation resting upon the teacher that he keep the development of the scientific mind just as clearly in view as the content of the science he teaches? In all this the chemist must do his part.

(4) In the next place, we should not lose the opportunity afforded by our course in chemistry to teach regard for natural law.

Dr. W. W. Campbell, the distinguished astronomer, makes the following statement in reference to natural law:

> If I were asked to name and describe the most wonderful fact known to man, my reply would be: So far

as our observations and experiences go, every particle of matter in the physical universe is endowed with the property and necessity of obeying the fundamental laws of nature. Our universe of stars, our own star and our earth in all its parts have been developed throughout long ages, to their present state, under the guidance and compulsion of perfectly definite and apparently simple laws. We have no reason to suppose that these laws are ever set aside or varied in the slightest degree.

Many of these laws so govern the every-day experiences of our lives that even the most ignorant regard them. If one jumps off the housetop, one knows the penalty that will be exacted for ignoring the law of gravity. There are many other laws, however, not so obvious, which if ignored will exact a penalty affecting not only the individual but groups of individuals, and even the nation as a whole. I recall that in the chemical lecture room in which I sat as a student there was printed in large letters on the wall above the blackboard the sentence, "Nature makes no leaps." There it was day after day impressing a great fundamental truth upon the minds of the students. Perhaps this statement has not the dignity of a natural law, but it does express in a general way one of the habits of nature. The earth as it exists today did not leap into its present state. According to Sir James Jeans, 2,000,000,000 years of gradual development were required. Neither has man reached his present state overnight; it has, according to the same authority, taken some 300,000 years of slow development.

And natural law does not obtain only within the material side of the universe. The great principle of evolution is in the popular mind confined to man's derivation from a lower type; there is little understanding of the fact that the principle of evolution is of so wide an application that we have come to think of the growth of institutions and moral ideas and capacities for action as an evolutionary process. To ignore this law of slow development will as surely bring its penalty as to ignore the law of gravity. If "nature makes no leaps," then time is always a factor in development. Many of our troubles, individual, local and national, have been due to the fact that we are in too great a hurry to achieve results. We desire to improve present conditions by making a great leap. This tendency to become impatient and to get in a hurry has been the cause of more than one of our great wars, as well as of untold lesser troubles. The scientist has great respect for time, knowing that no matter how beneficial the final result may be or how strenuously we may exert ourselves to bring about the desired end, time is an essential factor in effecting the final solution.

We have only to look about us for illustrations of the trouble that results from refusing to regard this method of nature. For many years there was a slow but gradual progress made in overcoming the evils of intemperance. Through education and local option this progress continued slowly but surely. Then we got in a hurry, and almost overnight, under stress of emotion and by vote of the people we made a leap from a position in which a large percentage of our people could legally obtain liquors as a beverage to one in which no one could legally do so. By vote we substituted compulsion for education and continued development of ideas and good habits. And many seemed to be surprised at the results. Now, having ignored this fundamental habit of nature, we find ourselves in a pretty fix. Whether to go on in the hope that, somehow, in due time natural processes will catch up with our attempt and come to our rescue, or whether to return to a former position and to reach the desired end gradually but surely, is one of the most perplexing problems before the nation. The scientist does not expect the miraculous. His interest is centered not so much in bringing about a temporary improvement as in accomplishing a permanent result; and he is willing to wait the necessary time.

Recently we have been witnessing an effort on the part of our federal government to assist the agricultural interests of our country. It is very doubtful, to say the least, whether the temporary withdrawal of large supplies of grain in an effort to maintain the price is in accord with well-known principles of economics. Indeed, it would seem that such a procedure, even if temporarily successful, would continue to call forth increased production—a situation which every one should realize must be avoided if the goal of price maintenance is to be permanently attained. Some of our legislative bodies have a committee whose duty it is to see that every proposed bill is in accord with the constitutional law. It might be equally well to have a committee of competent persons to determine if the proposed bill is in accord with natural laws.

If our nation is to prosper and civilization to advance, we must take into account these fundamental laws and work patiently and intelligently in the light of them. Some of us are evidently too old to learn this or too egotistical to believe it; the young men and women in our colleges are neither. The importance of regard for natural laws should be impressed upon them in no uncertain way in the hope that future generations may be wiser than we. Again, who are better qualified to do this than our teachers of sciences, and upon whom does the obligation rest more heavily?

(5) Another fundamental fact that our course in chemistry should stress is the oneness of all science. How often the teacher of chemistry is informed by the student that he does not care for physics so he is

going to study chemistry, or that chemistry does not interest him and so he is going to study physiology, or even that he does not care for organic chemistry and so he is going to confine his studies to inorganic chemistry. We are partly to blame for this state of affairs since in the development of science we enclosed each branch of science with barriers that were well-nigh insurmountable by either student or teacher. Happily these barriers have been torn down, although not all of them in their entirety.

Furthermore, the existence of departments in our colleges and universities often misleads the student, and the present tendency to unite certain existing departments into a single one rather than to multiply them is a hopeful sign and will lead to greater efficiency. To-day no one can draw a definite line between the domain of chemistry and that of physics. Courses that are given in one university in the department of chemistry are sometimes, with perfect propriety, given in the department of physics in other universities. We are beginning to wonder if these two departments could not be united into a single department, greatly to the advantage of both student and teacher and the advancement of research.

While the barriers that formerly separated the different divisions of science have largely disappeared, disclosing a most fruitful field of study and investigation, at least traces of them still exist within each division. In our department of chemistry we rarely give courses in chemistry, but in organic chemistry or analytical chemistry or some other branch of the subject. Moreover, each division is apt to have its own special guardian, who sometimes posts his territory with "keep off" signs. Instances are by no means unknown in which the teacher whose investigations led him from his own special branch into another, as is certain to be the case, was made to feel that he was trespassing in forbidden fields. Dr. Langmuir stated last year before the division of chemical education that the course in mathematics from which he derived the greatest good was not a course in trigonometry or analytical geometry or calculus, but simply a course in mathematics in which the teacher made his selections at will from whatever branch of the subject lent itself to an understanding of the fundamental principles of mathematics as a unit. I have often thought that an admirable course in chemistry would be one in which the science was considered as a unit, and not broken up into divisions. Such a course would impress upon the minds of the students the unity of the different divisions into which, for the sake of study, we divide the domain of chemistry. Even the graduate student to-day finds it difficult to conceive chemistry as a whole. When called upon to take an examination in the field of chemistry he is likely to insist upon knowing not only the branch of the subject but also the particular course in which the examination will be given.

(6) Many of the topics that lie within the domain of chemistry are not only of fundamental importance to an understanding of the science itself but illustrate in an admirable way the development of the scientific method of study or some other important principle. Such a topic as the constitution of matter illustrates what I have in mind. Not only is this topic of primary importance in itself, a foundation stone upon which the superstructure of science is built, but the wise teacher will not fail in the discussion of the subject to use it also as an illustration of the scientific method of attacking a problem. He will point out that here we have theory in the process of making. Within a short space of time our ideas concerning the make-up of the atom have undergone radical changes, and we fully realize that the end is not yet. There is a tendency on the part of some persons to lose faith in scientists because of their changing views. But to cling to ideas not in accord with our present tested knowledge is as deplorable as the willingness to change our minds with every new whim or idea, to be blown about with every new suggestion made. Even our greatest scientists are sometimes guilty of this inertia of mind toward accepting new knowledge. The spectacle of the great Priestley, clinging to and defending the phlogiston theory, in the light of the experiments of Lavoisier and others, always seemed to me pitiable in the extreme.

May I give another illustration? Not long ago I chanced to meet an old student of mine, now grown to manhood and distinguished in many ways, especially in the domain of literature. I had an irresistible impulse to ask him whether he had derived anything of value from his course in chemistry, fully realizing that the question might prove an embarrassing one to both teacher and pupil. But it did not prove so to either, for to my great surprise he stated that if he had to select the one idea that he had gained from his college course that had been of greatest service to him in framing his philosophy of life it would be the one derived from a discussion of the periodic law. He had been much confused by what seemed to him an entire absence of order in the universe; he had read that "all this scene of man" is "a mighty maze but not without a plan"; yet he could find no convincing evidence of this plan; and he recognized for the first time in his study of the periodic law unmistakable evidence of order in the universe, for in no other kind of universe could one predict not only the existence of unknown elements, but the properties of these unknown elements as well.

This same question is still in the minds of many

students. Modern discussions concerning the universe seem to them to add uncertainties, notwithstanding the judgment of such an authority as J. A. Thomson, when he writes, "Gone is the old sense of bewildering confusion. Every day discloses some new orderliness in the Universe." But the thoughtful student will realize that a helter-skelter world is not a world in which one can predict with a great degree of certainty the existence of either unknown elements or unknown stars. And if all is not yet clear he will realize, in regard to our knowledge:

'Tis a half-time, yet Time will make it whole.

(7) If history is of value in bringing to us the experience of the past in order that it may be a guide to us in the present, then it would seem that the history of our science may well play an important part in our general course. Our students must understand that chemistry did not reach its present state of development in some miraculous way but as the result of centuries of research carried on by alchemists, by "natural philosophers" and experimenters, often at heroic cost; that chemistry is a tremendously growing, developing science right now to which the student may be the one to make a future contribution as far reaching in value as those made by the great chemists of the past and of the present.

The history of chemistry can also be made to illustrate in an admirable way the development of the scientific method of study. In the old days many facts and phenomena were attributed to the forces of nature, to the gods or the devils, rewarding or punishing men, as the case might be. But the scientific method was born. Men began to experiment, to reason, to frame hypotheses, to test them to see if they would not serve to explain the facts. If they did not, the hypotheses were modified or new ones framed, until at last a working theory was evolved. As time went on new facts brought to light may have necessitated further change in theory or caused the substitution of an entirely new one in its place. The phlogiston theory served its day but gave way to the onward march.

Moreover, the study of the history of chemistry can hardly fail to have an influence upon the student's attitude towards life, call it his philosophy of life if you choose. He is no longer in fear of the displeasure of evil forces or imaginary spirits whose anger must be constantly appeased. If he is ever to be struck by lightning, as some one has said, in effect, he knows that it will be due not to the anger of the god of thunder but because under the existing conditions his body offers the least resistance to the passage of the electric discharge. Moreover, he knows how to avoid these conditions and the lightning loses its terror. He realizes that he is living in a world governed not by chance or whim but by natural laws; that he can count absolutely upon the action of these laws; he knows that they will never be set aside either to his advantage or to his disadvantage. He feels secure, then, in ordering his life in accord with reason and not subject to the wild chance of unknown forces.

Perhaps, from the statements I have made, some may think that I would rob the fundamental course largely of its chemical content; that I would present the play without the actor who really makes the play. To all such let me recall the statement already made that the course must deal with chemistry, fundamental chemistry. What I am pleading for is that the course should be in accord with our modern ideas of education; that it should stress fundamental laws and principles rather than mere isolated facts, and that whenever any of these laws have an application beyond the domain of chemistry there should be no hesitation in suggesting this application. It may be that a course so constituted would leave less time for the discussion of purely chemical facts; but this does not concern me. An examination of the various courses in chemistry in at least some of our colleges leads one to believe that we are expecting the student to learn all there is to know about chemistry while in college, rather than to build a foundation for future development. My principal theme is that our teachers of chemistry have a great opportunity not only to train the future chemists of our country but also to train our young men and women in the ways of right living and sound scientific thinking.

And finally the teacher of chemistry, in his enthusiasm for the value of science, must not forget that after all science is not everything. For the teacher who has awakened great enthusiasm in his students, who has developed in them the scientific habit of thought and a knowledge of the place of chemistry in the whole field of science, has not done quite his best for them unless he has reminded them by frequent suggestions and by his own attitude that science is but one way of thinking—not the only way; indeed, in the last analysis, it is "a method plus its body of significant knowledge." The other great departments of university work should be a constant reminder of this; the science student too often feels separated from them, and sometimes he even feels he has outgrown them. He must be made to realize that science does not give us the values of life, it does not harness its knowledge to ideal interests. Professor Dewey tells us that "the standing problem of modern philosophy is the relation of science to the things we prize and love, which have authority in the direction of conduct." Indeed, it may be that a great change is going on in our sense of values and in the basis of their authority, so that our aims may be confused, and we

may have a long way to go in our enlargement from individual to social ideals. But in furnishing knowledge, sought out for the very testing of values, in a creative attitude and a method of building toward the "good life," the scientific worker has a great contribution to make. His may be the optimism, when faith is failing in some other domain of the spirit; a humble attitude toward his own part, a generous understanding of the larger whole in which his work finds its significance.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE FOURTH CLEVELAND MEETING

PREPARATIONS for the fourth Cleveland meeting of the American Association and associated societies are well advanced. The meeting is to open on the evening of Monday, December 29, and it will continue throughout the week. This promises to be one of our larger and more comprehensive meetings. More than thirty independent scientific organizations are planning to hold meetings in connection with the association this year and all sections of the association will be represented. The American Statistical Association, the American Sociological Society, the American Economic Association, the American Political Science Association, the Stable Money Association, the American Association for Labor Legislation, the American Association of Teachers of Marketing and Advertising, the American Association of University Instructors in Accounting and the Farm Economics Association are also making arrangements to meet in Cleveland in convocation week. Their sessions are to be held in the downtown hotels, while the association sections and the other societies will hold most of their sessions in rooms of the Case School of Applied Science and Western Reserve University, which are adjacent.

According to the rules, the council of the association will meet Monday afternoon for its first Cleveland session and other council sessions will be held at 9 o'clock on the following days. Council members are asked to attend. The executive committee will hold a session on Monday morning. Business to come before the council at Cleveland is to be referred to the executive committee first, and memoranda concerning such business should be in the Washington office by December 20. Communications that arrive late, especially those coming to the permanent secretary after the opening of the meeting, may fail to receive consideration, for the week of the meeting is a very busy one for all officers of the association.

Reduced railway rates for this meeting have been granted by the railway associations, on the certificate plan, as in recent years. Any one wishing to go to Cleveland for the meeting should purchase a one-way ticket and secure a certificate for the meeting of the American Association for the Advancement of Science. Names of societies do not need to be mentioned. Upon arrival at the meeting the certificate is to be handed in at the registration office. After being endorsed and validated it will be returned to its owner, who may then purchase a return ticket at one half the regular fare. This arrangement applies for practically all places in the United States and Canada.

The Hotel Statler is to be general headquarters for the American Association. Hotel headquarters for the sections and societies have been designated as follows:

Hotel Statler: Section A (Mathematics), American Mathematical Society, Mathematical Association of America, Section B (Physics), American Physical Society, American Meteorological Society, Section D (Astronomy), Metric Association, American Association of University Professors.

Hotel Hollenden: Section F (Zoological Sciences), American Society of Zoologists, Entomological Society of America, American Association of Economic Entomologists, American Society of Parasitologists, Wilson Ornithological Club, Section G (Botanical Sciences), Botanical Society of America, American Phytopathological Society, American Society of Plant Physiologists, American Society of Naturalists, Ecological Society of America, American Microscopical Society, Phi Sigma Biological Research Society, Section N (Medical Sciences), American Society of Tropical Medicine, Section O (Agriculture), American Society of Agronomy, American Society for Horticultural Science, Potato Association of America, Association of Official Seed Analysts, American Nature Study Society.

Hotel Winton: Section H (Anthropology), American Anthropological Association, American Folk-Lore Society, Section I (Psychology), Section L (Historical and Philological Sciences), History of Science Society, Section Q (Education), Section C (Chemistry), Section E (Geology), Section M (Engineering).

Hotel Cleveland: Section K (Social and Economic Sciences).

The hotel headquarters for the social-science groups are as follows:

Hotel Statler: American Statistical Association, American Political Science Association.

Hotel Hollenden: American Sociological Society.

Hotel Winton: Stable Money Association.

Hotel Cleveland: American Economic Association, American Association for Labor Legislation, American Association of Teachers of Marketing and Advertising, American Association of University Instructors in Accounting, Farm Economics Association.

These hotels are within walking distance of one another and about four miles from the university grounds, with excellent street-car and bus service.

Those who plan to attend the Cleveland meeting should engage rooms in advance. The most desirable rooms are apt to be engaged first and delay may result in some disappointment. Letters requesting the engagement of rooms should be addressed to the hotels. Whether the room desired is to be occupied by one or by two persons should be specified, also the price which the applicant wishes to pay and the date on which the room is to be occupied. If the sort of room requested is not available for the given date the hotel management will refer the request to the Cleveland Convention Board, which will tentatively assign a suitable room in another hotel, informing the applicant by letter. If the applicant does not wish to accept the assignment thus given he should inform the Convention Board, which will do its best to comply with his wishes. All the rooms in the hotels named above are equipped with baths and the daily charge for a single room is $3.00 and up. For double rooms the daily charges are: Hotel Cleveland, $5.00 and up; Hotel Hollenden, $6.00 and up; Hotel Statler, $4.50 and up; Hotel Winton, $4.50 and up.

An extensive list of Cleveland hotels has been prepared by the permanent secretary's office, with the assistance of the Cleveland Chamber of Commerce, and a copy of this may be had on request addressed to the American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. The list shows the hotel locations and their daily prices for single and double rooms, with and without bath. Those who desire inexpensive rooms should write for a copy of the list. Prices for single rooms generally range from $2.00 or $2.50 upward, for double rooms from $3.00 upward.

At the opening session on Monday evening, December 29, Dr. Robert A. Millikan will give the retiring presidential address for this annual meeting. All workers in science and friends of science will be interested. The Sigma Xi Lecture, on Tuesday evening, December 30, will be given by Dr. C. E. K. Mees. The Gibbs lecture (under the auspices of the American Mathematical Society and the American Association) will be given on Tuesday afternoon by Dr. Edwin B. Wilson. There will be general lectures every afternoon and every evening, as at recent annual meetings. The science exhibition will be specially interesting this year, with a number of striking research exhibits. The General Program will be available at Cleveland Monday morning. Members of the association who are unable to attend the meeting may have a copy promptly mailed to them without charge if their requests are in the permanent secretary's office in Washington by December 20.

Further notes on arrangements for the Cleveland meeting will appear in SCIENCE from time to time and the "Preliminary Announcement" will be published in the issue for November 28.

BURTON E. LIVINGSTON,
Permanent Secretary

OBITUARY

MEMORIALS

TRIBUTE TO THE LATE HARVEY W. WILEY

THE Association of Official Agricultural Chemists, at its forty-sixth annual convention, held in Washington, D. C., on October 20, 21 and 22, set aside, according to the *Official Record* of the U. S. Department of Agriculture, part of the second day's session to honor the memory of Dr. H. W. Wiley, former chief of the Bureau of Chemistry and one of the founders of the association, as well as its second president and, from 1912 to 1930, its honorary president. Until 1929, when illness confined him to his home, Dr. Wiley attended every meeting of the association and the talk he gave was usually the outstanding feature of the program.

Dr. W. W. Skinner, assistant chief of the Chemical and Technological Research, Bureau of Chemistry and Soils; Dr. W. D. Bigelow, one-time assistant chief of the Bureau of Chemistry and now the chief chemist for the National Canners' Association, and Mrs. M. T. Read, editor, and Mr. F. B. Linton, assistant to the chief, Food and Drug Administration, all of whom were associated with Dr. Wiley through his fight for the passage of the food and drugs act, recalled vividly the qualities of the teacher, the public servant, the boss, and the man that made their chief an outstanding figure.

Mr. W. G. Campbell, who, as director of regulatory work of the department and chief of the Food and Drug Administration, is carrying on the control of the country's food and drug supply begun by Dr. Wiley, paid tribute to his former chief as "the leader." Dr. C. A. Browne, assistant chief of the Bureau of Chemistry and Soils, stressed Dr. Wiley's reputation as a

chemist throughout Europe, as well as in the United States. Mr. H. A. Huston, a member of one of the first classes conducted by Dr. Wiley at Purdue University, spoke of "the organizer." Mr. A. S. Mitchell, secretary of the food standards committee, gave tribute to "the pioneer."

THE College of Physicians of Philadelphia held a meeting October 23 to commemorate the anniversary of the birth of Galen, called the founder of experimental physiology. Ninety-three of the ninety-eight Galen publications, the property of the college library, were on exhibition. The meeting was addressed by Drs. William H. Welch, Charles W. Burr, Burton Chance and Giuseppe Franchini, of Bologna, Italy.

RECENT DEATHS

OLIVER PERRY HAY, retired associate of the Carnegie Institution of Washington, known for his researches in Pleistocene paleontology and as author of the "Catalog and Bibliography of the Fossil Vertebrates of North America," died on November 2 in his eighty-fourth year.

EDWARD WYLLYS HYDE, for twenty-five years professor of mathematics at the University of Cincinnati and formerly treasurer and actuary of the Columbia Life Insurance Company, has died at the age of eighty-seven years.

HENRY EMERSON TREFETHEN, associate professor of astronomy at Colby College, died suddenly on November 3. He was seventy-five years old.

DR. CHRISTIAN EIJKMAN, professor of hygiene and medicine at the University of Utrecht, to whom the Nobel Prize in medicine was awarded for his work on beriberi, died on November 5, at the age of seventy-two years.

DR. WALDEMAR MORDECAI WOLFF HAFFKINE, known for his work on Asiatic cholera, died at Lausanne, Switzerland, on October 27, at the age of seventy years. He discovered the principle and method of inoculation with attenuated virus against cholera. The Haffkine method of inoculation has been generally adopted throughout India and the government plague research laboratory founded by Dr. Haffkine has issued many thousands of doses to various tropical countries.

SCIENTIFIC EVENTS

THE FRENCH PUBLIC HEALTH SERVICE

RECENT mortality statistics for France are reported in the *Journal* of the American Medical Association to have caused deep regret. The birth rate in France had risen, whereas it was declining elsewhere in Europe. The mortality had begun to drop down somewhat and the whole country was pleased over the fact, when suddenly it began to rise again. From 675,110 in 1928, it rose to 741,104 in 1929, or 70,000 deaths more, in which the deaths of the new-born played but an insignificant part. The increase concerns chiefly the adults. The correspondent writes: "The condition can be due only to the inadequate nature of the public health service, in spite of all the exertions made in this direction. It is becoming more and more clear that the law of 1902 in regard to public hygiene, a law recognized by all as inadequate and which there is constant talk of amending, although nothing is done, is the true cause of this sad state of affairs. The fundamental weakness of the present law, to which frequent attention has been called, is that it leaves to the mayors of the communes the task of applying the hygienic measures that are needed. Unfortunately, however, the authority and influence of the mayor in the majority of the rural communes are entirely inadequate to the needs of the situation. Furthermore, the mayor, being dependent on the voters for his reelection, is not inclined to punish vigorously infractions of the health regulations. Then, again, though the mayor may be honest in his endeavors, many of the communes are too poor to carry out the hygienic measures that are needed; for example, for the installation of a modern water system; or for the care of the indigent or of the mentally ill who have to be transported to the hospitals of the neighboring city. It is in such situations as this that government aid appears to be indicated. But it would require the expenditure of immense sums throughout France if the government were to attempt to do everything for the poorer communes that considerations of health might dictate. However, considerable sums have been appropriated by the government during the past two years to aid the communes, either in the form of subventions or in the form of loans at a low rate of interest, more particularly for the installation of water systems. Hygienic undertakings, which are the next thing in order after the introduction of a water system, may be aided to the extent of 800,000 francs ($32,000) in place of 400,000 francs ($16,000), as formerly. From the foregoing, it would appear unfortunate that improvement in the public health service, on which the lowering of the mortality depends, is a question of finance."

THE BRITISH NATIONAL PHYSICAL LABORATORY

THE report of the National Physical Laboratory for 1929, summarized by *The British Medical Journal*, contains a detailed account of the many investiga-

tions on which that institution is continually engaged. These cover the fields of general physics, radiology, acoustics, optics, electrical standards and measurements, wireless, metrology, aerodynamics and metallurgy. During last year the physics department of the laboratory was engaged on the measurement of several grams of radium purchased by the National Radium Trust for distribution by the Radium Commission to the centers authorized to receive it. This work has involved the testing of the platinum containers for leakage as well as the determination of the radium content. An instrument has been designed at the laboratory for the rapid visual identification, with the minimum of handling, of the large numbers of radium needles, tubes and applicators which come to Teddington for testing. There was noted during the year a marked increase in the number of tests on feebly active preparations, such as radio-active waters, ores, luminous compounds and the like. In X-ray measurement the workers in the department have been establishing the international unit of radiation, the "Roentgen," or "*r*" unit, which was adopted at the Stockholm conference in 1928, and measuring the pastille dose in this unit. Investigation into certain problems relating to the energetics of X-rays has been started, and the construction of a constant voltage generator for this purpose is well advanced. Among the problems which it is proposed to examine is the variation of X-ray output with tube voltage, anticathode material, and the angle which the X-rays make with the target surface and with the exciting cathode rays. The testing of protective materials and the inspection of X-ray equipment and hospital installations in accordance with the recommendations for X-ray and radium protection have been continued. Some interesting work has also been done on sound, a line of research to which little attention was paid until recent years. The production, reception and analysis of sound and speech, and their reproduction, transmission and magnification for broadcasting, telephony and similar purposes, have brought many problems to the laboratory. Experiments are in progress for the Aeronautical Research Committee with the object of reducing the noise of the flight of aeroplanes. High speed in an aeroplane contributes much to noisiness; an increase in 100 feet per second in speed multiplies the sound tenfold. The noise in the cabin of an aeroplane is stated to be one thousand times that in an express train. A portable noise-measuring instrument has been devised for preliminary work, and a number of measurements of air-screw noises have been made. Street noises, in particular the noise due to motor horns, are also being investigated. On the subject of glare—a parallel infliction—the laboratory is working on the effects of colored light sources, and on the problem of vision under night-driving conditions. Another useful side of the National Physical Laboratory's work is temperature research undertaken for the Food Investigation Board, including a study of distant-reading thermometer outfits. An electric resistance thermometer designed at the laboratory for cold storage work has been patented. A refrigerating railway truck, built for one of the railway companies, has been the subject of test. The truck is provided with a small methyl chloride refrigerating plant driven from the axle. A number of investigations have been made on long-distance journeys, which have shown that the plant is capable of cooling the truck and its cargo sufficiently rapidly, and also that the rate of temperature rise when the plant is not in operation is sufficiently slow. One part of the routine work of the laboratory is the testing of clinical thermometers. More than ten thousand of these were tested last year, and the demand for individual certificates showing the actual corrections at various points of the scale has increased by thirty per cent., as compared with the number issued in the pervious year.

THE WALTER RATHBONE BACON SCHOLARSHIP OF THE SMITHSONIAN INSTITUTION

UNDER the terms of the will of the late Virginia Purdy Bacon, of New York, the Smithsonian Institution some years since was bequeathed the sum of $50,000 to establish a traveling scholarship as a memorial to her husband, Walter Rathbone Bacon, for the study of the fauna of countries other than the United States. The amount available is the interest on the capital invested (about $3,000 a year), the incumbent to hold the scholarship not less than two years.

Applications for this scholarship, addressed to the secretary of the Smithsonian Institution, should be submitted not later than January 31, 1931. The application should contain a detailed plan for the proposed study, including a statement as to the faunal problems involved, the reasons why it should be undertaken, the benefits that are expected to accrue, the length of time considered necessary for the carrying out of the project, the estimated cost and the scientific and physical qualifications of the applicant to undertake the project.

The scholarship will be awarded for a term of two years. If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance, accompanied by a statement as to the necessity for such extension.

All collections, photographs, records and equipment become the property of the institution.

The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship.

C. G. ABBOT,
Secretary

SUMMER SCHOOL FOR ENGINEERING TEACHERS

THE Society for the Promotion of Engineering Education announces that two sessions of its Summer School for Engineering Teachers will be held in 1931.

The first, on the teaching of chemical engineering, will be held at the University of Michigan from June 24 to July 14, inclusive. This session is being held in response to a suggestion by the American Institute of Chemical Engineers. Professor Alfred H. White, chairman of the department of chemical engineering of the University of Michigan, will serve as the local director.

The second, on the teaching of mathematics to engineering students, will be held at the University of Minnesota from August 24 to September 5, inclusive, in conjunction with meetings of the American Mathematical Society and the Mathematical Association of America, to be held at Minneapolis beginning September 7. This session of the school will be under the direction of Dean O. M. Leland, of the College of Engineering and Architecture, University of Minnesota.

The two sessions for 1931 will bring the total number of sessions held since the establishment of the school to eleven. This undertaking, which was begun in 1927, has now attracted 750 teachers to its sessions. The attendance has represented all parts of the United States and Canada and all teaching ranks. From small beginnings, with attendances of 40, the sessions have grown in numbers, 190 teachers attending those of 1930.

The programs are devoted primarily to principles and methods of teaching the principal subjects of engineering curricula. The contents of courses, including classroom procedure, examinations and tests, departmental organization and other topics relating directly to the major purposes of the school, are presented through lectures, informal discussions and in seminar periods. Incidental attention is also given to the history of the subject, coordination with other subjects of the curriculum, advanced phases of the subject, relationship with engineering practice and other topics.

Members of the school, including the staff, live together for the duration of the sessions in a dormitory of the institution acting as host. Recreational features are provided as a part of each session. It is expected that from 50 to 100 teachers will attend each of the sessions of 1931 as "students." The teaching staffs, as in the past, will be recruited from among the leading teachers, engineers and scientific men of the country. Professor H. P. Hammond, of the Polytechnic Institute of Brooklyn, is the general director of the school.

SCIENTIFIC NOTES AND NEWS

THE University of Paris presented honorary doctorates on November 8 to Dr. John Dewey, professor of philosophy at Columbia University, and to Professor P. Zeeman, professor of physics at the University of Amsterdam.

ON his return to Stockholm from China, in the spring of 1931, where he has been making explorations in Tibet and Mongolia, Dr. Sven Hedin will be presented with the first "Hedin Medal" by the Swedish Anthropological and Geographical Society.

AT a dinner on October 31 on the occasion of the presentation to Mr. Daniel C. Jackling by the American Institute of Mining and Metallurgical Engineers of the William Lawrence Saunders Gold Medal, Mr. John Hays Hammond, the 1929 Saunders medallist, was the toastmaster. The speakers were Mr. Newcomb Carlton, president of the Western Union Telegraph Company; Mr. Lafayette Hanchett, president of the Utah Light and Power Company and Mr. W. S. Boyd, assistant managing director of the Nevada Consolidated Copper Company.

THE REVEREND T. E. R. PHILLIPS, rector of Headley, Surrey, has been awarded the Goodacre medal and gift of the British Astronomical Association, in recognition of his work generally for the association and particularly of his observations and researches on Jupiter. Mr. Phillips already holds the Jackson-Gwilt medal and gift of the Royal Astronomical Society, of which body he has been president and secretary.

Nature reports that the Horace Brown Medal of the Institute of Brewing is awarded by the council for "eminent services on the scientific or technical side of the fermentation industries." The first award was made to Professor H. E. Armstrong in 1926, and the next recipient of the medal is to be Dr. E. S. Beaven, known for his work on barley. The presentation will be made by the president, Mr. Percy Gates, in the lecture theater of the Institution of Electrical Engineers, on November 21, when Dr. Beaven will deliver the memorial lecture on "The Culture of Barley for Brewing."

AT the centenary celebration of the Royal Geographical Society, Mr. E. John Voüte, Amsterdam, one of the foreign delegates, presented to Sir Francis Younghusband the gold medal of the K. Nederlandsch Aardrijkskundig in recognition of his work in geographical research and his services to the Royal Geographical Society, of which he was honorary secretary and president. Diplomas conferring honorary membership of the Dutch society were presented to Sir Charles Close, Mr. Douglas W. Freshfield and Mr. A. R. Hinks, secretary of the Royal Geographical Society. Commander Maury, a delegate of the Belgian Geographical Society, presented diplomas of honorary membership to the president and secretary.

REAR ADMIRAL RICHARD E. BYRD will be presented the gold medal of the Geographical Society of Chicago on November 16 in recognition of his expeditions to the North and South Poles. Admiral Byrd will be the ninth person to receive the medal since its inception in 1913.

DR. HUGO ECKENER has been elected president of the Aero Arctic Society, Berlin, as successor to the late Fridtjof Nansen.

DR. ROBERT TAIT MCKENZIE will retire as professor of physical education and physical therapeutics at the University of Pennsylvania on the completion of a survey of student health, but will retain an affiliation with the university. He will devote most of his time to sculpture. He was sculptor of the Franklin statue at the University of Pennsylvania, the Scottish-American War Memorial at Edinburgh and the War Memorial in the Parliament Building at Ottawa.

DR. LYNDS JONES, professor of animal ecology and curator of the zoological museum of Oberlin College, has retired from active service. He has been asked to give his full time during the current year to recataloguing and rearranging the museum.

AFTER forty-seven years' service to Vassar College, Dr. Elizabeth B. Thelberg, of the department of physiology and hygiene and resident physician of the college, has retired.

LORD D'ABERNON has been elected president of the National Institute of Industrial Psychology, in succession to the late Earl of Balfour, its first president.

UNDER the Order in Council dated February 6, 1928, the Lord President of the Council has appointed Dr. E. J. Butler, Dr. Kenneth Lee and Dr. N. V. Sidgwick to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The following members of the Advisory Council have retired on completion of their terms of office: Professor V. H. Blackman, Professor F. G. Donnan and Professor F. A. Lindemann.

DR. RALPH H. CHENEY, chairman of the biology department at the College of Arts and Sciences, Long Island University, has been awarded a grant by the American Academy of Arts and Sciences for further study of the action of caffein on the neuro-muscular mechanism.

PROFESSOR R. C. ARCHIBALD, of the department of mathematics at Brown University, has been appointed a lecturer in mathematics at Harvard University for the second semester.

DR. WILLARD C. RAPPLEYE, professor of hospital administration at Yale University and director of the New Haven Hospital, has been made associate professor of medical economics at the Harvard University School of Public Health, beginning in February.

DR. CARL H. LENHART was recently added to the faculty of the School of Medicine of Western Reserve University, Cleveland, as professor of clinical surgery and as chief of the division of surgery of the City Hospital. Dr. Lenhart will retain his office as director of the surgical division of St. Luke's Hospital, but will give half his time to the new position at City Hospital.

DR. CLAUDE S. BECK, assistant professor of surgery in the School of Medicine of Western Reserve University, was given the title of "professor *pro tempore* of surgery" by Emory University at Atlanta, Georgia, where he was acting as an exchange professor from November 2 to 9, as a substitute for Dr. Daniel Elking. On November 6, Dr. Beck addressed the Fulton County Medical Society in Atlanta on "Surgery of the Pericardium."

PROFESSOR R. B. THOMSON, head of the department of botany of the University of Toronto, who has been granted a year's leave of absence on account of his health, is spending the winter in the south, visiting Trinidad, Jamaica, British Guiana, etc.

DR. A. W. HILL, the director of the Royal Botanic Gardens, Kew, has left England to make a tour in the Union of South Africa on the invitation of the Government of the Union of South Africa. Dr. Hill expects to visit the botanical and allied institutions around Capetown, Port Elizabeth, Johannesburg and Pretoria and to pay a visit to Natal. The government has deputed Dr. I. B. Pole Evans, chief of the division of botany of the Department of Agriculture, Pretoria, to arrange for the tour and to accompany Dr. Hill. On leaving South Africa on January 2, Dr. Hill will proceed to Uganda and Kenya, by arrangement with the Colonial Office and the respective gov-

ernments. He will then go to the Amani Institute, Tanganyika Territory, to attend the Conference of Directors of Agriculture to be held at Amani at the end of January. He will be attending this meeting with Mr. F. A. Stockdale, agricultural adviser to the Secretary of State for the Colonies. Dr. Hill expects to return to Kew early in March, going home from Mombasa by the East Coast.

THE twenty-fourth Hanna Lecture of Western Reserve University was delivered at the Institute of Pathology on October 31 by Professor M. Weinberg, of the Pasteur Institute, Paris. His lecture was on "The Rôle Played by the Anaerobes in the Etiology, Pathogenesis and Evolution of Infectious Diseases." Dr. Weinberg will lecture on November 19 and 20 at Iowa State College, where he will speak on the relation of anaerobic bacteria to infectious diseases and on the seral therapy of polymicrobic infections.

DR. K. S. LASHLEY, professor of psychology at the University of Chicago, will deliver the second Harvey Society Lecture at the New York Academy of Medicine, on Thursday evening, November 20. His subject will be "Mass Action and Localization of Functions in the Cerebral Cortex."

THE Science Forum of the New York Electrical Society, jointly with the Museums of the Peaceful Arts and the New York section of the American Institute of Electrical Engineers, has arranged a demonstration and a lecture entitled "Play-o-fine Crink-a-nope" (a sample of scrambled speech), by Mr. Sergius P. Grace, assistant vice-president of the Bell Telephone Laboratories, on November 19 at 8:15 P. M., at Mecca Temple, 133 West Fifty-fifth Street, New York City. Owing to the demand for seats the lecture will be repeated the following evening.

THE Fifth Pacific Science Congress will be held in Victoria and Vancouver, British Columbia, Canada, between May 23 and June 4, 1932, under the auspices of the National Research Council of Canada. Previous congresses in this series were held at Honolulu, 1920; at Sidney and Melbourne, Australia, 1923; at Tokyo, Japan, 1926, and at Batavia and Bandoeng, Java, 1929.

THE Society of American Foresters will hold its thirtieth annual meeting in Washington, D. C., from December 29 to 31. It is expected that Colonel W. B. Greeley, former chief of the Forest Service; Dr. Ray Lyman Wilbur, Secretary of the Interior, and Dr. John C. Merriam, president of the Carnegie Institution, will give their views on the public-land policy of the United States, and that foresters, including Inman F. Eldredge, forester of the Superior Pine Products Company; E. F. Jones, forest engineer of the Great Northern Paper Company, and J. E. Rothery, forest engineer of the International Paper Company, will set forth the accomplishments of private forestry enterprises.

DR. JOHN A. FERRELL, of the Rockefeller Foundation, New York, was elected president of Delta Omega, the honorary public health society, at the annual meeting held in Fort Worth, Texas, on October 29. Dr. Ferrell succeeds Dr. C. C. Young, of Lansing, Michigan. Other officers elected were Drs. James A. Tobey, New York, *vice-president,* and Professor Ira V. Hiscock, of the Yale School of Medicine, New Haven, *secretary-treasurer.* Dr. George W. McCoy, director of the National Institute of Health, Washington, D. C., was elected an honorary member of the society. Delta Omega now has 316 members, distributed in six chapters at the Johns Hopkins School of Hygiene and Public Health, the Harvard School of Public Health, the Massachusetts Institute of Technology, the University of Michigan, the Yale School of Medicine and the University of California. The honorary members of the society include President Hoover, Surgeon General H. S. Cumming, Dr. Charles V. Chapin, Dr. F. F. Russell, Sir Arthur Newsholme, Dr. W. S. Rankin and Dr. S. Josephine Baker. The society has made arrangements with the American Public Health Association for the reprinting of Dr. William Budd's classic work on typhoid fever, which first appeared in 1873.

SECTION I (Psychology) of the American Association for the Advancement of Science will hold its sessions on Friday, January 2, in Cleveland at a place to be designated later. Professor Madison Bentley, of Cornell University, the retiring vice-president of the section, will give the vice-presidential address at the afternoon session on January 2 on "Psychology's Family Relations among the Sciences." The meeting of Section I has been set on January 2 so as not to interfere with the meetings of the American Psychological Association on December 29, 30 and 31 at Iowa City. It is possible for persons who wish to attend both meetings to reach Cleveland easily in time for the meetings of Section I. All fellows and members who wish to read papers should submit titles with an estimate of the time required up to a limit of 20 minutes, to the secretary of the section not later than November 22. The preliminary announcement of the section meetings will appear in SCIENCE, and the final program will appear in the general program of the association. The headquarters of Section I will be in Hotel Winton.

AT the meeting on November 7 of the Johns Hopkins Fellowship Conference, President Joseph S. Ames announced the endowment of eight new fellowships in

the national chemical fellowship plan. The purpose of the department of chemical education, of which Dr. Neil Gordon is the head, is to obtain fellowships which will bring a student to Johns Hopkins from every state and from foreign countries. The Coca Cola Company, of Atlanta; G. A. Pfeiffer, of New York, and the Central Chemical Company of Chicago, each gave one of the new fellowships; the American Can Company, three, and the Chemical Foundation of New York, two. Thirty fellowships have now been founded. Two fellowships at large, contributed by Mr. Francis P. Garvan, who endowed the chair of chemical education under which the national fellowship plan is operating, will also soon be put into effect.

PLANS to unite the engineering profession, educational institutions and the industries in improving engineering education are announced by H. Hobart Porter, chairman of the Engineering Foundation. A Research Committee on Education, headed by Dr. Harvey N. Davis, president of Stevens Institute of Technology, will frame a program whose objective will be to meet the demands of industry and public service for professional education of high quality. Dr. Davis's associates on the committee are Professor William B. Plank, of Lafayette College; Professor Harold B. Smith, of the Worcester Polytechnic Institute; Professor Alfred H. White, of the University of Michigan; Mr. Robert E. Doherty, consulting engineer of Scotia, New York, and General R. I. Rees, of the American Telephone and Telegraph Company.

PLANS have been announced for the erection of a new building at the Massachusetts Institute of Technology, housing unusually complete physics and chemistry laboratories. Funds are available from the gift of $2,500,000 given by Mr. George Eastman in 1916. Beside the laboratories, the new structure will include a shop for the construction and maintenance of delicate instruments used in research work, a large lecture room, and a joint library and reading room for the use of students in physics and chemistry.

THE State Department of Public Welfare and the College of Medicine of the University of Illinois recently dedicated four buildings—The State Orthopedic Institute, The Institute for Juvenile Research, The Nurses Home and The Research and Educational Hospital Service Building between Lincoln and Wood Streets, Chicago, on October 29. These buildings are units of the Research and Educational Hospital operated by the University of Illinois. Mr. A. L. Bowen, superintendent of charities of the State of Illinois, presided. Addresses were given by Governor Louis L. Emmerson, Dr. Harry Woodburn Chase, president of the University of Illinois, and Rodney H. Brandon, director of the Department of Public Welfare. After the dedication the cornerstone of the Medical and Dental Laboratory Building, to be erected at a cost of $1,500,000, was laid. These laboratories are designed to accommodate two hundred students in a class. The Research and Educational Hospital has a capacity of four hundred and fifty beds.

APPLICATIONS for associate biochemist (animal body fluids) must be on file with the United States Civil Service Commission, Washington, D. C., not later than December 10. The entrance salaries range from $3,200 to $3,800 a year. This examination is to fill vacancies in the Bureau of Animal Industry, Department of Agriculture, for duty in Washington, D. C., and in the field. Competitors will not be required to report for examination at any place, but will be rated on their education, training and experience, and on a thesis or published writings.

DR. CLARENCE J. WEST sends the following correction to the article on doctorates in the sciences 1929–30: "The Registrar of the State University of Iowa informs us that an error was made in transmitting to us the number of doctorates conferred in the sciences by Iowa in 1929–30. Instead of nine, as reported in Table V (SCIENCE, 72: 357, Oct. 10, 1930), Iowa should be credited with twenty-eight. The new data make necessary the following correction in Tables III and IV: Chemistry, 317; zoology, 102; psychology, 97; physics, 91; mathematics, 75; metallurgy, 4; total, 1,074.

Nature reports that the twenty-first Annual Exhibition of Electrical, Optical, and other Physical Apparatus will be held by the Physical Society and the Optical Society from January 6 to 8, 1931, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a trade section and a research and experimental section, and the section for the work of apprentices and learners, introduced at the last exhibition, is to be continued. The research and experimental section will be arranged in three groups: (*a*) exhibits illustrating the results of recent physical research; (*b*) lecture experiments in physics; (*c*) historical exhibits in physics. No charge will be made for space or catalogue entries in the research and experimental section.

THE *Journal* of the American Medical Association reports that on recommendation of the Royal Commission on Public Welfare in Ontario, Premier Ferguson has announced the creation of a department of public welfare with the Honorable W. G. Martin as minister. The commission advises that public funds finance the general hospitals, which now receive for indigent patients a grant of 60 cents daily

per patient from the province, and $1.75 daily per patient from the municipality. The total general hospital revenue last year was $10,140,782. The commission emphasized the need of a government owned psychiatric hospital and to assist institutional schools in caring for Ontario's 6,000 crippled children, 2,000 blind and 3,000 deaf and dumb persons, recommended the division of the province into ten districts, in each of which will be stationed a graduate nurse or social worker supervised by a special government officer. It was recommended that the raising of funds to effect other recommendations of the commission should be patterned after the Quebec plan, in which more than $600,000 is raised annually by a hospital tax of 5 per cent. of the cost of all meals over $1, levied in hotels and restaurants. Among the recommendations was one which advised that a special conference of medical men be convened to study cancer treatment and that the province establish a cancer hospital and purchase a supply of radium. Emphasis was laid on the need of preventive clinics, provisions for occupational training for convalescents, and aid in the rehabilitation of tuberculosis patients on discharge.

ACCORDING to *Nature*, with the cooperation of the authorities of various national museums, the British Museums Association organized a short training course for curators during the week of October 6–11. The course was attended by thirty-three students from provincial museums, for the most part junior assistants, though a few seniors were glad to avail themselves of this opportunity. The gathering was welcomed in the new Conference Hall at the Science Museum by Sir Henry Lyons, when an opening address on first principles of museum work was given by Dr. F. A. Bather, and Dr. E. E. Lowe discussed some fundamental points in museum practice. Succeeding days were devoted to the Victoria and Albert Museum, with demonstrations on textiles, wood furniture, ceramics, prints and the circulation department; the Natural History Museum, with demonstrations on habitat groups, casting of whales, preparing spirit specimens, and preparation of fossils for exhibition; the National Galleries in Trafalgar Square and at Millbank, with talks on storage, cataloguing and the explanation of pictures; the laboratory of the British Museum, with a lecture on restoration of Egyptian relics.

DISCUSSION

SOME CRITICISMS OF "RACE CROSSING IN JAMAICA"

IN SCIENCE, No. 1850, Castle criticizes Jennings and me for certain conclusions drawn by Steggerda and me in "Race Crossing in Jamaica" (1928) and utilized by Jennings in his book "The Biological Basis of Human Behavior." The vigor of Castle's criticism reminds me of a boyhood experience, when absorbed in watching a procession. A woman next to me let out a shriek, crying, "You are stepping on my corns." Castle has two well-developed scientific corns: one, that size factors in mammals are general factors affecting all parts of the skeleton simultaneously (Castle, 1914); the other, that no disharmony results from race crossing.

The first corn is irritated by the finding of Steggerda and me (1929) that blacks have longer legs than whites, both absolutely and relatively to stature. Castle had previously[1] criticized me for finding a difference in leg length between Negro and Amerind. While in our Table 67 the difference in absolute leg length between blacks and whites is not much greater than the probable error of the means, the differences in relative leg length amount to 2 per cent., which strikes us as considerable, as anthropometric differences go. Also, the superiority of blacks in length of the leg and its segments is shown in all the other germane tables, namely, relative kneeling height, stature minus kneeling height and tibiale height (length of lower leg + foot). The difference between blacks and whites in these tables is consistent and in some cases considerable. The differences in absolute length of lower leg is 5 times the probable error.

That the proportions of trunk to leg do differ in different races of mankind is indisputable. If Castle will refer to Martin's "Lehrbuch der Anthropologie," 2d Aufl., pp. 411 and 412, he will find conclusive evidence of this. From his tables Martin draws the conclusion: "The relative leg-length of Negroes, Veddahs, some East Indians and Australians is especially large."

That Castle apparently still maintains his old position, though with some shifts (Castle, 1924, p. 20), is the more remarkable in view of the keen analysis of Wright (1918), who shows that in Castle's rabbits bone lengths vary to a certain extent independently. Also there are groups of bones that vary together and independently of the rest of the body. "Again," says Wright, "the bones of the hind leg (femur and tibia) form a group subject to common influences which do not affect the humerus, a bone of the fore leg."

The second irritating conclusion of mine is that in individual browns there occurs a deviation from the average proportions of leg length to arm length that is found in the parent races, white and black. Castle doubts if such a disharmony is possible. Not all the

[1] In Publication No. 320 of the Carnegie Institution.

evidence for our conclusion can be given here. It lies, in part, in the great range of dimensions of the arm and leg lengths in the browns as compared with either whites or blacks alone as shown in Tables 43 to 46, 48, 49, 52 to 54, 66 to 68, 72. That despite the usual large range the standard deviation of the browns is not always the highest of the three racial groups is probably due to the fact that the browns are the most rigidly selected of all, about half being students at Mico College.

That species hybrids can form highly variable zygotes including those that die in embryo or at a later developmental stage is well known among plants[2] in both first and especially second hybrid generations. If species hybrids, often apparently through the presence of genes with conflicting tendency, die, there is nothing extraordinary in the finding that in a less extreme cross viable but not fully harmonious progeny may be produced in F_2. That disharmonious instincts appear is easily demonstrated in dogs and poultry. That morphological disharmonies appear is well illustrated by Bryn's findings on the easily dislocated hips of Norwegian-Lapp hybrids, and the still unpublished findings of Stockard with dog hybrids.

The capacity of the organism through self-adjustment to make good some gene deficiencies is no doubt very great. But it has its limits. I have myself seen one of twins who, at birth, lacked even bilateral symmetry of the legs.

Finally, a word of protest against some misrepresenting phrases that Castle (no doubt unwittingly) has introduced into the discussion. He says, "Perhaps it is leg length in relation to total stature that puts browns at a physical disadvantage in relation to whites and blacks." This certainly distorts our conclusion. We never stated that "browns" were at a physical disadvantage; we stated precisely "some of the hybrids." We certainly never drew the conclusion that the Negro-white cross is inferior to the Negro or the whites; but we did find some cases of browns that seemed to present greater extremes—and sometimes less well-adjusted extremes—than either of the parental races. Our conclusion is not as Castle suggests it is, that the browns "are a degradation of the white race." Our conclusion is given at p. 477: "While, on the average, the Browns are intermediate in proportions and mental capacities between Whites and Blacks, and although some of the Browns are equal to the best of the Blacks in one or more traits still among the Browns there appear to be an excessive per cent. over random expectation who seem not to be able to utilize their native endowment."

[2] See Renner, in "Handbuch der Vererbungswiss.," Bd. II.

In *Nature*, No. 3177, Professor Karl Pearson publishes a critical review of "Race Crossing in Jamaica." His main complaints are based on the fact that the samples are insufficient—the adults of the 6 groups running from 50 to 93 per group. There is nothing to be said on this point except that funds and time were limited and the numbers of adults cited are all that we could, under the circumstances, secure. Whether results based on such small numbers were worth publishing is a question on which different opinions may be held. The committee thought they were worth publishing. The uniform computation of probable errors was relied upon to indicate the limits of significance (or insignificance) of the numerical results.

In regard to another matter about which Pearson complains, *viz.*, homogeneity of material, this is discussed from page 5 to 19; also pages 20 and 22. We do not recall any work of this nature where the homogeneity of the material is discussed more fully. Certainly we had in mind the desirability of genetical purity of the blacks, and think that we have eliminated the hybrids nearly as successfully as we could have done it for the "West African Negroes" to whom Pearson refers, mixed as they have been from time immemorial with Arabians and Jewish traders. If 2 or 5 per cent. of errors were made it would not have changed, we think, the essential conclusions of the work. The whites certainly included no "pass-for-whites," as they were taken from very segregated white populations.

C. B. DAVENPORT

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INDUCED PARTHENOGENESIS AND HOMOZYGOSIS

THE report of the production of homozygotes through induced parthenogenesis in Nicotiana and Fragaria, by Dr. East,[1] may justify a short review of parthenogenesis in the grouse locusts (Tettigidae). During attempts, 1915–18, to cross males and females of *Paratettix texanus* with those, respectively, of *Apotettix eurycephalus*, it was observed that the comparatively few resulting offspring were homozygous for the dominant segregate, or cross-over color patterns of the females, were themselves females and showed no trace of the dominant characteristics of the males. It was at first thought and noted that perhaps the development of the eggs had been in some way induced, or initiated, by the males of the opposite species, or by their products. However, before publication[2] it had been ascertained that the parthenogenesis

[1] SCIENCE, August 8, 1930.

[2] *Amer. Nat.*, 53: 131–142, 1919.

was in no way consequent upon the activities or products of the males. Still later[3] more than 5,000 females and 13 males of *A. eurycephalus* had been produced parthenogenetically, mostly from females which had not been exposed to males of any kind, and some of them had been carried seven consecutive generations without exposure to males.

Comparable results were obtained from the parthenogenetic breeding of *P. texanus*[4] and *Telmatettix aztecus*.[5]

All the partheno-produced individuals, including two males which were tested by further breeding, with one or two possible exceptions, proved to be homozygous for the several characteristics noted. The two tested males and several of the females, taken at random, were examined cytologically by W. R. B. Robertson. He has ascertained[6] that the homozygous pairs, respectively, of the chromosomes of the soma and oogonia lie together in early cell divisions, and not far apart, each from the other, in later cell divisions, in such position as to suggest that the second polar body division had been inhibited.[4] The second polocyte division in the grouse locusts, as in other forms, is probably normally consequent upon the entrance of the sperm, another case of "a later stage of maturation being overlapped by an early stage of fertilization."[7] In the absence of the fertilizing sperm and the resultant complete or partial inhibition of the last polocyte division, the diploidal condition is retained or restored, and if the specific or complementary genes responsible for the parthenogenetic processes are present, a chemical situation arises which conditions the initiation of development. Since it appears that any egg of these species is capable of being fertilized (those without the genes responsible for parthenogenesis require it), such educement of development may, perhaps, be considered *induced* or *artificial* parthenogenesis.[4]

It should be noted that Peacock and Harrison (1925–6)[8] advanced the very interesting hypothesis *that parthenogenesis was consequent upon hybridity*, using as a basis their work with hybrid moths from the crossing of *Tephrosia bistortata* males with *T. crepuscularia* females, and finding support from the materials used and results of the parthenogenetic breeding of the grouse locusts (*loc. cit.*). This hypothesis is probably valid, but it should be provided, in addition, that the process of hybridism may bring together specific, complementary or climaxing genes which are responsible for, or cause, as a kind of hybrid emergence,[9] the development of the unfertilized egg.

The list of instances of tychoparthenogenesis among such organisms as the grouse locusts, moths and, apparently, the plants used in Dr. East's experiments is constantly augmenting, and it is probably as yet far from complete. If a mutation, or stable, hybrid emergence, of sufficient transcendence should occur among the females of such, and since males do occasionally occur, certainly among the parthenogenetic grouse locusts, at least one long recognized major difficulty besetting the supposition of species transmutation might be considered as partially obviated.

ROBERT K. NABOURS
KANSAS AGRICULTURAL EXPERIMENT STATION AND CARNEGIE INSTITUTION, DEPARTMENT OF GENETICS

[3] *Kansas Tech. Bull.*, 17, 1925.
[4] *Biol. Bull.*, 66 (2): 129–155, 1929, and *Bibliographia Genetica*, 5: 27–104, 1929.
[5] *Genetics*, 13: 126–132, 1928.
[6] *Jour. Morph.*, 1930.
[7] E. B. Wilson, "The Cell," 1925.
[8] See literature cited, *Biol. Bull.*, 66: 155.

MUSICAL PITCH AND PHYSICAL PITCH

THE suggestion made by W. B. White in SCIENCE of September 19, that men of science entirely abandon the pitch standardization based on making middle C equal to 256 cycles, is a healthy one. But his positive suggestion of substituting for it a standard A of 440 cycles could serve well only those acousticians who are concerned with problems of music, that is, the esthetic-artistic side of acoustics. On the other hand, telephone engineers and psychologists interested in sensation units or in hardness of hearing and like problems which have no direct relation to music ought to use 1,000 cycles as their primary pitch standard and multiples and fractions of 1,000 as their auxiliary standards, such as 50, 100, 250, 500, 1,000, 2,000, 4,000, 5,000 cycles.

The remark by Mr. White that the discrepancy between any artificial scales used by physicists and musicians becomes particularly serious in the higher regions is meaningless to musicians, since mistuning in all regions is to them a purely relative matter. Physicists, however, will no longer suffer if they wholeheartedly, instead of half-heartedly as in their middle C custom rightly criticized, emancipate themselves from the orchestra leaders. The present writer happens to be equally interested in mere hearing and in music; and he has for almost a lifetime found a complete divorce of the two methods of standardizing extremely satisfactory for both purposes. By all means let every man of science for all purposes abandon the middle C of 256 cycles. But audiometers and similar instruments ought to be standardized on a decimal scale of cycles having 1,000 as its center.

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[9] SCIENCE, April 11, 1930.

EUSYNTHETOLOGY OR EURHETICS

IN the issue of SCIENCE for September 26, Dean Seashore presents the merits of the word *euphany* as a term to denote the "deliberate and adequate" expression of thought. The etymology of the word is satisfactory, but I can not pronounce *euphany* in a way to distinguish it from *euphony,* and it is difficult to write it so that any one can tell which word I mean. Besides, I should not like to call the distinguished dean a *euphanist.* It sounds belittling. I should prefer to call him a *eusynthetologist.* This word is made up of familiar Greek roots, and means "one who puts words together well." It lends itself to all the variations of ending which might be needed, such as *eusynthetology and eusynthetological.* Of course the word *eusyllogothetist* would provide the better order of roots, but it would sound strange and difficult. A course in advanced English composition, if it gave sufficient attention to the organization of thought, might be called *eusynthetology.*

An easy short word would be *eurhesis* or *eurhetics.* The latter could be modified into *eurhetical* or *eurheticist.* The word has the advantage of coming from the same root as our present word rhetoric, and yet its strange sound might prevent popularity.

J. F. MESSENGER

UNIVERSITY OF IDAHO

SPECIAL CORRESPONDENCE

THE TWENTY-SIXTH ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGIC EXCURSION

THE annual field trip of the New England geologists was held in the vicinity of Amherst, Massachusetts, on October 10 and 11. Professors F. B. Loomis and G. W. Bain, of Amherst College, and Professor C. E. Gordon, of the Massachusetts Agricultural College, were the guides.

The excursion of Friday afternoon started from the Lord Jeffrey Inn. The first locality visited was Bull Hill in Sunderland at the southern end of Mount Toby. Here an ancient lava flow from the west terminated against an alluvial fan spread from the block mountains to the east. The lava thinned out eastward as it rested upon the slope of the fanglomerate.

The excursion then continued its way along the road east of Mount Toby, halting to observe a Triassic valley filled by conglomerate. The conglomerate now forms reentrants into the crystalline rocks toward the east. Later a spur of the crystalline rocks was visited which formed a projection westward into the Triassic basin, and the contact of the Triassic sediments with the ancient basement rocks was studied. Faults in the crystalline rocks which did not cut the Triassic conglomerates had dips toward the east. The problem of the origin of the faulted eastern boundary of the Triassic basin was discussed. Was it produced by normal or by thrust faults? What was the approximate altitude of the block mountains?

The last stop of the afternoon was made in the locality of the Sunderland caves. Here a section of crumpled shales underlies a narrow wedge of conglomerate. Since the shales are conformable with overlying sandstones at either side of the wedge, it is inferred that their disturbed structure was produced by the wedge of conglomerate. A number of theories were suggested for the local folding of the shales. Some suggested a mudflow following a sheetflood in a semi-arid region. Others favored slumping attendant on the melting of winter's ice. Still others believed the conglomerate was projected out onto the plastic mud which later formed the shales by the bursting of a dam across the outlet of a lake.

After dinner at the Lord Jeffrey Inn, an evening meeting was held at the geology laboratory of Amherst College. The excellent collection of vertebrate fossils arranged under the direction of Professor Loomis attracted special attention. The discussion of the evening was led by Professor George W. Bain. The evidence concerning the origin of the eastern boundary of the Connecticut Triassic basin which had been seen during the afternoon was summarized and it was concluded that there were certain facts which pointed to compressive, rather than tensional, forces as the agents active in the formation of the Triassic basin.

Saturday morning there were two excursions. The first group visited localities in Whately, Hatfield and Northampton, where sections of the Triassic sediments were exposed and where fossil footprints might be seen.

The second party made a study of the granites and accompanying pegmatites of Whately, Hatfield and Northampton. At the northern end of Northampton reservoir a dike, approximately eight inches across, had large feldspar crystals at its center and finer crystals at its edge. It was crossed by quartz veins like the rungs of a ladder. The veins were about three quarters of an inch wide and, where they bordered on the intruded schist, penetrated the wall rock. The origin of the quartz forming the veins provoked considerable discussion. Was it segregated

from the immediately surrounding rock or was it derived from a remote source after the dike had solidified, contracted and formed the openings perpendicular to the cooling surface into which the quartz was introduced?

A granite quarry in Northampton likewise provoked considerable discussion. The basic igneous rock originally present had been intruded by later pink granite dikelets bringing with them allanite and epidote. The occurrence was quite similar to the Salem gabbro-diorite at Blueberry Hill, Woburn, Massachusetts.

The two parties were united at the luncheon served in the Tavern, Northampton. After lunch we returned to Amherst and followed the state road southward through the Notch near Mount Norwottock. At the Notch a stop was made to collect datolite and prehnite from a trap quarry and to study the faulting which formed the Notch.

Continuing our way toward South Hadley we stopped at the second trap sheet separated from the first or main sheet by southward-dipping sandstones. Here fragments of basalt occurred mingled with the conglomerate, and it was suggested that an explosive vent was present with outward-dipping slopes of agglomerate.

The excursion ended at this locality about four o'clock Saturday afternoon after two days of perfect weather and of most interesting field study. There were twenty-six colleges and institutions represented by more than seventy persons.

The excursion in October, 1931, will be held in the vicinity of Westerly and Newport, Rhode Island. The leaders will be Professors C. W. Brown and R. M. Brown, of Providence.

WILBUR G. FOYE

WESLEYAN UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE APPARATUS FOR MEASURING CATALASE ACTIVITY IN PLANT AND ANIMAL TISSUES

THE apparatus here described was designed primarily for the study of "ropiness" of bread. We find it useful also for catalase determinations in tissues. The apparatus is shown in Figs. 1 and 2. It is used as follows.

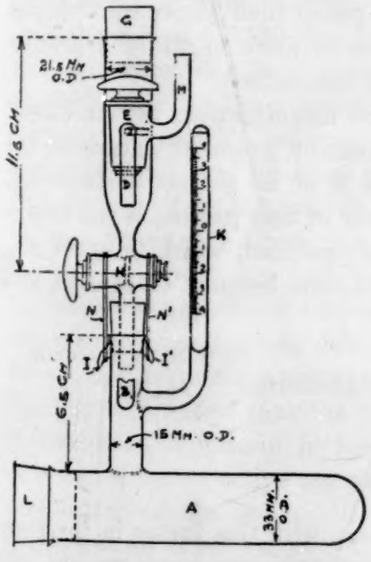

FIG. 1.

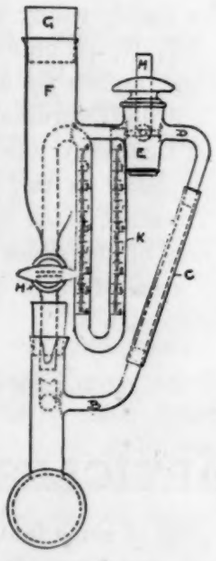

FIG. 2.

Twenty-five grams of the tissue are ground with 50 cc of tap water and made up to 75 cc with tap water. By holding the apparatus at a slant with opening of compartment A tilted upward, the fluid mass is poured with constant stirring into compartment A. The remaining particles of pulp are flushed into the apparatus with 10 cc of tap water additionally added. Stopper L is now inserted tightly. A large glass jar such as a battery jar is filled with water within half an inch from the top. The water should be nearly room temperature (within 1° F.), so that its temperature will not change appreciably during a period of fifteen to twenty minutes. Glass stopcock E is so set as to let air escape or enter through upward bent vent tube M. To hold funnel more securely in place, stopcock H is attached to glass hooks I and I^1 by means of two rubber bands, N and N^1. The apparatus is now suspended in the water-bath by running a glass rod under the upper bend of the manometer tube K and the horizontal tube connecting F with stopcock E. This glass rod will neatly support, therefore, the apparatus at two points and will itself rest on two points on the rim of the glass jar. To establish uniform temperature conditions the apparatus remains in the water-bath for a period of ten minutes. (It is best to take the tap water for making up the tissue pulp out of the jar containing the water at adjusted temperature.) During the interval of waiting there is introduced into the funnel F 10 cc of 3 per cent. hydrogen peroxide which has been adjusted to the temperature of water-bath. The hydrogen peroxide fills funnel F almost to the side tube leading to stopcock E. There is also introduced into manometer K mercury to fill both graduated arms up to the points O. Rubber stopper G is inserted tightly into funnel F.

When the ten minutes required for equalization of temperature have elapsed, stopcock E is turned through an angle of 180°, thereby closing all communication of main body of apparatus with the out-

side but maintaining communication of main body of apparatus with funnel F through rubber tube C. Now stopcock H (immersed under water) is opened, allowing solution of hydrogen peroxide to flow from funnel F into compartment A. This compartment has the capacity of 100 cc; with 95 cc of liquid introduced there remains a 5 cc "air bubble" facilitating agitation. The whole apparatus is given a gentle shake or two and the time noted. Readings are made in millimeters on manometer K at intervals of one minute for five minutes.

If activity of the tissue is so great as to bring about a maximum reading in less than five minutes, amount of material is reduced to 10 grams or even to 1 gram. We have worked in this laboratory with materials which in amounts of .2 gram bring about a maximum excursion in less than five minutes.

To express the activity in terms of units generally acceptable we adopted the following definition: A unit of catalase activity will cause liberation in five minutes of 1 microgram (.000001 g) of oxygen per gram of tissue. We have prepared a table which enables the experimenter to quickly convert manometric readings into catalase units. This tabulation requires too much space to be given in this note. Copies of the table will be mailed by the author on request. The apparatus and accessories can be secured from The Emil Greiner Company, 55 VanDam Street, New York City.

H. H. BUNZELL

WOMAN'S MEDICAL COLLEGE
OF PENNSYLVANIA

MEASURING SLIDE FOR CLASS USE

THE ruled millimeter slide intended for use in low power dissecting microscopes, while indispensable for serious accurate work, is somewhat costly when considered for class use involving a quantity of slides. This, coupled with the liability of breakage in inexperienced hands, makes the use of the white celluloid metric rule the common measuring instrument in most elementary classes of taxonomy. The author has found an efficient substitute that can be made with ordinary photographic materials.

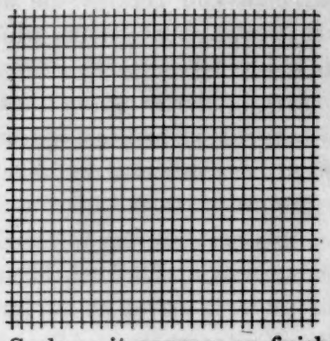

FIG. 1. Scale as it appears on finished slide.

A piece of paper is ruled with cross lines at 3-mm intervals to form a cross-ruled block 9 cm square. This is photographed on a process plate to produce an image of exactly one third the size of the original. This can be readily gauged on the ground glass with a pair of dividers set at an opening of 3 cm. The negative should be developed in a suitable contrast developer having sufficient potassium bromide to keep the lines absolutely clear while allowing the rest of the plate to become as dense as possible.

This negative printed on a slow lantern slide plate will produce a scale sufficiently accurate for any class work involving the measurement of small floral parts, seeds and fruits. A thin cover-glass bound on the slide will protect the surface from scratches. Students find scale drawings of floral parts easily made by lightly ruling with pencil their paper into squares of 5, 10, 20 millimeters or more in size and making their figures by direct comparison.

With the ordinary low magnifications used in classes of taxonomy, the essentially granular nature of the emulsion on the plate is of no serious consequence. The chief point in favor of this process is the cheapness of the slides thus produced, which in supplying a class of 20 or 30 students becomes of considerable importance.

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SPECIAL ARTICLES

THE RELATIONSHIP IN THE HEN BETWEEN THE DEVELOPMENT OF OVA, BLOOD CALCIUM AND THE ANTIRACHITIC FACTOR

OBSERVATIONS were made of the number of ova larger than 1 cm in diameter and of the blood calcium level of 30 pullets in June, 1929, which was toward the close of their first year of laying. They had been maintained for 8 months on a ration deficient in the antirachitic factor but which was supplemented, in the case of some individuals, with this factor in the form of cod-liver oil, irradiated ergosterol or sunlight through an ultraviolet-transmitting material, Cel-O-Glass.

Regardless of whether or not the antirachitic factor had been supplied, the presence of ova greater than 1 cm in diameter was accompanied by a blood calcium level between 13.0 mg and 26.7 mg per 100 cc of serum. The diameter of 1 cm was selected arbitrarily as the dividing line between developing or mature ova

and those which either had not developed or had just started to develop. When no ova greater than 1 cm in diameter were observed the blood calcium level was between 13.0 mg and 7.5 mg. Eight of the group of 30 pullets had been deprived of the antirachitic factor for a period of 8 months before killing and consequently were not actively producing eggs, although they had not started to molt. In spite of this deprivation, the presence of large ova was accompanied by a blood calcium level greater than 13.0 mg.

Ten pullets were maintained on the same basal ration for a period of four months longer; these were of the large group of which 30 had been killed and they had received their antirachitic factor throughout the eight-months laying period in the form of irradiated ergosterol, in an amount biologically equivalent to 10 times the 2 per cent. of cod-liver oil which is frequently used in poultry rations. During July and August the amount of irradiated ergosterol was doubled, but this did not stop the waning egg production associated with molting. Early in September, the feeding of 2 per cent. of cod-liver oil was begun in place of the ergosterol and continued until the end of the experiment. Observations of the ova and blood calcium of the 10 individuals were made early in the month of October when the birds were in a molting condition. Nine had no ova larger than 1 cm in diameter, and their blood calcium was 13.7 mg or below. One individual showed a blood calcium of 16.0 mg and 4 large ova were observed.

On November 5, 1929, five hens in a molting condition, but which had been exposed to all the sunlight available each day for a period of 6 weeks, were killed for observation. No ova greater than 1 cm in diameter were noted, and the blood calcium level was below 13.0 mg except in one case in which a value of 13.5 mg was obtained. Although an adequate amount of the antirachitic factor had been supplied to these individuals a high blood calcium did not prevail and ova greater than 1 cm in diameter were not present. In an earlier preliminary experiment (unpublished data) it was found that the feeding of daily doses of irradiated ergosterol to hens not in a molt, but which were not in active egg production because of a deprivation of the antirachitic factor, caused active production to take place.

The data show that the presence of large ova and high blood calcium does not always indicate active egg production, and suggest that the antirachitic factor may not be necessary in the development of ova, at least, it may not be the essential factor involved in the development, and that the antirachitic factor may not be the sole factor in causing high blood calcium.

Although a biological test, the use of the white rat, indicated that the basal ration was devoid of the antirachitic factor, it is realized that traces of this factor may have been present in the ration which permitted only a slow development of ova and occasional production of an egg.

Riddle and Reinhart[1] have shown that high blood calcium prevails in female pigeons at each ovulation period, and Hughes, Titus and Smits[2] report that high calcium prevails in hens which are in production, and low calcium in those which are molting. Our results confirm those of the above investigators with the exception that high blood calcium is not always associated with active egg production. Recently, Buckner, Martin and Hull[3] reported high calcium values for actively producing hens and for those not in active production, whereas molting hens showed a low value. Our records also confirm this report.

Whether the development of ova caused the blood calcium to rise or whether an increase in blood calcium stimulated ova formation will have to be investigated further, but it should be noted that high blood calcium was never found unless developed or developing ova were present.

It is of interest to note that Hess, Bills, Weinstock and Rivkin[4] found the blood calcium of the cod to be high at the spawning season although the eggs are without shells. In the case of the hen the presence of ova, although eggs with shells were not being produced frequently, was accompanied by a high calcium level.

Observations of 49 hens and pullets in June of this year have confirmed our previous results, and an extended report of this investigation is being prepared for publication.

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THE QUANTITATIVE DETERMINATION OF BACTERIOPHAGE

IN a recent paper[1] the writer described a comparative method for the quantitative determination of bac-

[1] O. Riddle and W. H. Reinhart, *Am. J. Physiol.*, 76: 660, 1926.

[2] J. S. Hughes, R. W. Titus and B. L. Smits, SCIENCE, 65: 264, 1927.

[3] G. D. Buckner, J. H. Martin and F. E. Hull, *Am. J. Physiol.*, 93: 86, 1930.

[4] A. F. Hess, C. E. Bills, M. Weinstock and H. Rivkin, *Proc. Soc. Exp. Biol. and Med.*, 25: 349, 1928.

[1] A. P. Krueger, "A Method for the Quantitative Determination of Bacteriophage," *Jour. Gen. Physiol.*, 1930, 13: 557–564.

teriophage. Briefly, the method depends upon the fact that with a set concentration of growing phage-susceptible bacteria and varying concentrations of phage, the time of lysis is a function of the initial phage concentration. An arbitrary turbidity standard is chosen as an end-point and the periods of time required to reduce to this level the dense bacterial suspensions in unknowns and in dilutions of "Standard phage" are recorded. (Standard phage is readily prepared in quantity. Its titer is defined in terms of arbitrary activity units and it may be kept at 4° C. for months without change in titer). By plotting the time required for the unknown to reduce the suspension to the standard end-point, the activity of the unknown solution may be calculated in terms of the activity of the standard phage with an accuracy of about ± 3 per cent.

Necessary conditions for satisfactory results are: (1) Constant temperature; (2) mechanical rocking of the test series to avoid settling of the bacteria; (3) accurate determinations of numbers of bacteria both in setting up the test and in reading bacterial concentrations during lysis;[2] (4) careful dilution technique and accurate time measurements.

Routine daily use of the method has brought out the following points in its favor: (a) Twenty to thirty unknowns may be conveniently run at once; (b) time required for the entire test is < 5 hours; (c) results are accurate to within ± 3 per cent., a figure based upon an analysis of the last 60 series run in this laboratory; (d) the procedure is definitely more reliable and is more easily carried out than either the plaque count or dilution technique ordinarily used in determining phage titers; (e) kinetic analysis of the phage-bacterium reaction predicts the relationship between phage concentration and time of lysis on which the quantitative determination depends.[3]

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THE MECHANISM OF ENHANCEMENT OF INFECTIONS BY TESTICLE EXTRACT[1]

IN a series of publications Reynals has reported the observation that testicle extract to a marked degree, and certain other organs to a less extent, enhance the lesions produced by vaccine virus and staphylococcus infections.[2] Hoffman has obtained similar results with several other viruses[3] and Pijoan with a number of other bacteria.[4] A possible explanation of the enhancement mechanism was suggested by the observation that the wheals resulting from intracutaneous injections of the infectious agents with testicle extract disappeared more rapidly than those resulting from injections of the agents with inactive organ extracts. On the basis of this clue a large series of experiments has been carried out in order to determine the effect of testicle extract on the diffusion of inert substances in the skin.

For the main experiments India ink was used as the test substance. A mixture of this suspension was made with equal amounts of the various organ or tissue extracts, and 0.25 cc of each mixture was injected intracutaneously in the shaved skin of rabbits. The maximum spread of all mixtures was reached within an hour, so this period was selected for measurements. The results of a number of experiments were as follows. The average size of the area of spread for India ink-testicle extract mixture was 4.5 x 3.5 cms, while that for the control of India ink and Ringer's solution was 2.5 x 2.1 cms. The other extracts with India ink gave less striking differences. Kidney and to a less degree spleen extracts gave spreads larger than the controls, but rat and rabbit serum seemed to be without effect on the diffusion of the ink.

Another point noted, which may have a bearing on the enhancing power of testicle extract, is that the ink particles were not only spread through a wider area under the influence of the factor, but great numbers of the particles were found either in the cells or adhering to the cells. With the inert extracts the injected particles lay in the tissue spaces with no especial contact with the cells. This suggests a second effect of the enhancing substance, namely, an increased permeability of the local host cells. The activity of the testicle extract in enhancing infections as well as increasing the spread of inert particles is destroyed by heating at 60° for 30 minutes.

The tentative conclusion indicated by these observations is that the enhancing property of testicle extract on infections is at least partly due to the fact that it increases the area of spread of the injected material and increases cell permeability. The details of the experiments with a fuller discussion will be given in a subsequent publication.

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[2] A. P. Krueger, "A Method for the Quantitative Estimation of Bacteria in Suspensions," *Jour. Gen. Physiol.*, 1930, 13: 553–556.

[3] A. P. Krueger and J. H. Northrop, "The Kinetics of the Bacterium-Bacteriophage Reaction," *Jour. Gen. Physiol.*, 14 (No. 2): 223, November 20, 1930.

[1] From the laboratories of the Rockefeller Institute for Medical Research.

[2] F. Duran-Reynals, *C. R. Soc. Biol.*, 99: 6, 1928; *J. Exp. Med.*, 50: 327, 1929. F. Duran-Reynals et J. Suñer-Pi, *C. R. Soc. Biol.*, 99: 1908, 1928.

[3] D. C. Hoffman, *J. Exp. Med.* (in press).

[4] M. Pijoan, *J. Exp. Med.* (in press).